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EXAMINER

ZERVIGON, R

ART UNIT

PAPER NUMBER

1763

6

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Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

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## Office Action Summary

Application No.

08/988,246

Applicant(s)

Sebastien et al

Examiner

Rudy Zervigon

Group Art Unit

1763

☐ Responsive to communication(s) filed on \_\_\_\_\_.☒ This action is **FINAL**.☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

## Disposition of Claims

☒ Claim(s) 1-18 is/are pending in the application.Of the above, claim(s) 7-10 is/are withdrawn from consideration.☐ Claim(s) \_\_\_\_\_ is/are allowed.☒ Claim(s) 1-6 and 11-18 is/are rejected.☐ Claim(s) \_\_\_\_\_ is/are objected to.☒ Claims 1-18 are subject to restriction or election requirement.

## Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.☐ The drawing(s) filed on \_\_\_\_\_ is/are objected to by the Examiner.☐ The proposed drawing correction, filed on \_\_\_\_\_ is ☐ approved ☐ disapproved.☐ The specification is objected to by the Examiner.☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).☐ All ☐ Some\* ☐ None of the CERTIFIED copies of the priority documents have been  
☐ received.☐ received in Application No. (Series Code/Serial Number) \_\_\_\_\_.☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

\*Certified copies not received: \_\_\_\_\_.

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

## Attachment(s)

☒ Notice of References Cited, PTO-892☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). \_\_\_\_\_☐ Interview Summary, PTO-413☐ Notice of Draftsperson's Patent Drawing Review, PTO-948☐ Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

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## DETAILED ACTION

### *Response to Arguments*

1. Applicant's arguments, with respect to claims 1-3 and 5, filed July 2, 1999 have been fully considered but they are not persuasive. With regards to the argument that Robertson, van de Ven, or Provence do not teach or suggest that it is advantageous to use an impedance monitor in a substrate processing systems as claimed in claim 1, the examiner reemphasizes the reference by Patrick et al as providing ample motivation and description for those of ordinary skill in the art to enhance the base reference of Robertson et al, van de Ven, and Provence. Specifically, as stated in the first office action, Roger Patrick et al. (U.S. Pat. 5,474,648) describe a dynamic control and delivery of radio frequency power in plasma process systems. The processing is utilized to enhance the repeatability and uniformity of the process plasma. Power, voltage, current, phase, impedance, harmonic content and direct current bias of the radio frequency energy being delivered to the plasma chamber may be monitored at the plasma chamber and used to control or characterize the plasma load. Dynamic pro-active control of the characteristics of the radio frequency power to the plasma chamber electrode during the formation of the plasma enhances the uniformity of the plasma (ABSTRACT).

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In addition, according to the following excerpt from column 3, the claim 1 limitation of *an impedance monitor electrically coupled to the deposition chamber to measure an impedance level* of the process plasma is explicitly met:

ling the radio frequency energy with a computer system. In addition, the voltage, current, phase and impedance of the 65 plasma chamber electrode may also be measured and the measurement information used by the computer power con-

From column 4:

#### 4

trol system of the present invention.

A control system that monitors and controls the radio frequency power at the plasma chamber electrode is illustrated in FIGS. 2A and 2B. This radio frequency power control system includes a radio frequency sensor placed closely to the plasma load electrodes in the plasma etching

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In addition, according to BSUM(24), The Patrick et al sensor may also measure the voltage, current and phase angle at the chamber electrode, and measure the chamber impedance as desired. In addition, Patrick et al describe a radio frequency ("RF") generator 102 as shown in Figure 2A is coupled to a plasma chamber 104 through a matching network 120 consisting of variable capacitors 106 and 108, and coil 110. The plasma chamber 104 includes a second RF electrode 112 and a *first substrate holder that positions the substrate in the reaction zone while supporting the substrate atop a first RF electrode 114*. a substrate 116 is in planar communication with the *substrate holder that positions the substrate in the reaction zone while supporting the substrate atop a first RF electrode 114*. An RF excitation is created between a *second RF electrode 112* and a *first substrate holder that positions the substrate in the reaction zone while supporting the substrate atop a first RF electrode 114*, and when a process gas or gases (not illustrated) is introduced into the plasma chamber 104, the gas turns into a plasma. The plasma reactively etches the surface of the *substrate 116*. In addition, according to DETD(4), the maximum transfer of RF power from the RF generator 102 to the plasma chamber 104 *second RF electrode 112* and a *first substrate holder that positions the substrate in the reaction zone while supporting the substrate atop a first RF electrode 114* results when the *plasma chamber 104 load impedance* is matched to the impedance of the RF generator 102. The values of coil 110 and *variable capacitors 106 and 108* are selected for an appropriate impedance transformation between the RF generator 102 and the plasma chamber 104 *second RF electrode 112* and a *first substrate holder that positions the substrate in the reaction zone while supporting the substrate atop a first RF electrode 114*. Variable capacitors 106

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and 108 may be *automatically adjusted* by a computer processor to obtain a substantially resistive termination for the RF generator 102. The claim 3 limitation of *a computer processor communicatively coupled to an impedance monitor where the computer processor receives the measured impedance as an input the measured impedance level of the process plasma* is explicitly met according to BSUM(22):

a dynamic control of the radio frequency energy with a computer system is accomplished. In addition, the voltage, current, phase and impedance of the plasma chamber electrode may also be measured and the measurement information used by the *computer* power control system of the present invention. In addition, according to BSUM(27), the power sensor connects to a *computer* power controller that uses the sensor information to dynamically and pro-actively control the output power of the radio frequency power generator so that a desired power profile over time is available.

With regards to the applicant's arguments that Patrick et al "do not teach or suggest changing the capacitance in response to a measured impedance value as recited in claim 4", the examiner's closer examination again supports the claim 4 limitations implicitly. However, to further emphasize that the Patrick et al reference implicitly meet the claim 4 limitations, attention is again drawn to column 7, lines 4-20 where the following is considered:

Process parameter measured by Patrick et al: Power. Supported by column 7, lines 14-15

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Relationship between power and impedance, common to those of ordinary skill, is provided in this office action<sup>1</sup>.

Capacitance is, in fact, changed in response to an implicitly measured impedance value as supported by column 7, lines 10-13.

2. In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971).

3. In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, the

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<sup>1</sup>Fitzgerald, A.E., Higginbotham, D.E., Grabel, A., Basic Electrical Engineering, McGraw Hill, 5th Ed., pp.132-134.

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examiner reemphasizes the reference by Patrick et al as providing ample motivation and description for those of ordinary skill in the art to enhance the base reference of Robertson et al, van de Ven, and Provence. Specifically, as stated in the first office action, Roger Patrick et al. (U.S. Pat. 5,474,648) describe a dynamic control and delivery of radio frequency power in plasma process systems. The processing is utilized to enhance the repeatability and uniformity of the process plasma. Power, voltage, current, phase, impedance, harmonic content and direct current bias of the radio frequency energy being delivered to the plasma chamber may be monitored at the plasma chamber and used to control or characterize the plasma load. Dynamic pro-active control of the characteristics of the radio frequency power to the plasma chamber electrode during the formation of the plasma enhances the uniformity of the plasma (ABSTRACT).

4. Applicant's arguments, with respect to claim 4, filed July 2, 1999 have been fully considered but they are not persuasive. Boys et al specifically teach a source 37 used to measure the voltage and provide a voltage signal to computer control system 58 of the voltage applied by the source between electrodes 15 and 16 (column 8, lines 25-30). The power measured by Patrick et al, discussed above, and the voltage measured by Boys et al provide the necessary unknowns needed to compute impedance, as known by those of ordinary skill, and provided according to equation 3-67 of Fitzgerald et al (refer to the foot note of page 5). Of further interest is the established fact that Patrick et al measures power to the plasma which if it is not equal to the driving power source then impedance is not matched, thus indirectly measuring impedance. Boys et al tie in plasma pressure as being a controlling variable for plasma impedance providing the necessary motivation (column



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9, lines 18-23). Thus motivation is provided by Boys et al to control the plasma pressure in response to one or a collection of input variables including measured voltage (column 8, lines 25-30). In this case, those of ordinary skill in the art would consider the measurements of impedance, as implicitly taught by Patrick et al to control the plasma pressure, as suggested by Boys et al, to be a mathematical alternative for the Boys et al voltage measurements for meeting the claimed limitations.

Boys et al in fact teaches a pressure control system as previously described, configured to control a pressure level within the processing chamber (column 9, lines 7-12). Although parameter setpoints are described (column 9, lines 43-46), embedded control from CPU 57 acts by comparing the error between the setpoints and the measured parameters. As such the response of CPU 57 is directly related to the error which is the difference between the signals processed, as discussed above, and the setpoints.

***Claim Rejections - 35 USC § 103***

5. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.
6. Claims 11-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bialko et al (U.S. Pat. 4,131,533) in view of Provence et al (U.S. Pat. 4,695,700). Bialko et al describe a radio frequency driven apparatus for sputter deposition on substrates (column 1, lines 5-8). Specifically,

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Bialko et al describe all the apparatus claim 11 limitations as cited (column 4, lines 25-34; column 4, lines 40-47). Additionally, Bialko et al describes the band width of the RF generators used as being with the FCC regulated low frequency and high frequency (column 3, lines 25-28). Bialko et al's variable impedance matching networks (column 4, lines 40-47) measure the impedance (column 4, lines 57-65) and provide a response to the power sources delivering power to the reactor. Bialko et al do not explicitly describe a gas manifold for supplying one or more process gases.

Provence et al, according to DETD(55), describes *gas distribution* 43 of FIG. 1 is applied to a *gas inlet manifold* 750 by a mass flow controller 721 through 724. The mass flow controllers are controlled by the analog inputs from the *computer* 10 and additionally valves 710 through 713 are controlled by the status I/O 3 of the *computer* 10 and are on/off valves. The gases mixed in the *gas inlet manifold* 750 and applied to the *plasma chamber* 37 where the temperature of the reaction within the *plasma chamber* is monitored by a thermocouple 751. The thermocouple 751 is an analog input to the analog I/O 5 of the *computer* 10. A vacuum pump 31 pulls a vacuum in the *plasma chamber* 37 when the block valve 709 is open. The flow rate is controlled by a throttle valve 708 which position is fed into the analog input and is set by the output from the analog input of the *computer* 10. Sensors 2 senses the position of the silicon wafer within the *plasma chamber* 37. The vacuum of the entry load lock 21 and the exit load lock 49 is provided by pump 29. The pump rates, and thus the system *pressure*, are controlled by throttle valves 704 and 706. The gate valves are interfaced in the *computer* 10 at the digital I/O 3 and the throttle valves 704 and 706 are controlled by the analog I/O card 5.

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It is the examiner's position that a person of ordinary skill in the art at the time the invention was made would have found it obvious to modify the Bialko et al radio frequency driven apparatus for sputter deposition on substrates by implementing the Provence et al *gas distribution* 43 of FIG. 1 applied to a *gas inlet manifold* 750 by a mass flow controller 721 through 724 because such an enhancement would, by the person of ordinary skill, be considered obvious. Motivation for the enhancement of the Bialko et al reference is drawn from the level of ordinary skill in the art, where such skill anticipates the introduction and control of a plurality of gases for the selective deposition of heterogeneous layers of materials atop a substrate. This described process is common to VLSI manufacture.

### ***Conclusion***

7. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be

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calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Rudy Zervigon whose telephone number is (703) 305-1351. The examiner can normally be reached on a Monday through Friday schedule from 8am until 5pm. The official AF fax phone number for the 1763 art unit is (703) 305-3599. Any Inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Chemical and Materials Engineering art unit receptionist at (703) 308-0661.

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**Bruce Breneman**  
**Supervisory Patent Examiner**  
**Technology Center 1700**